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The nesting habits of the hen

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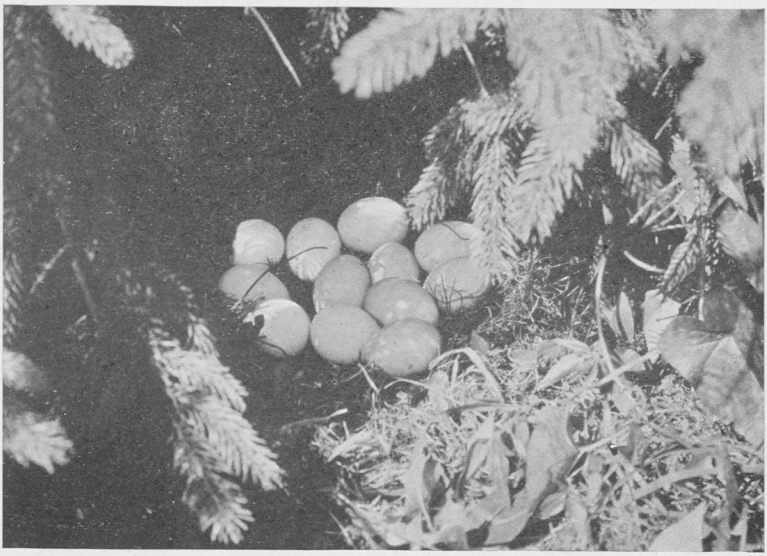
THE NESTING HABITS OF THE HEN



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THE NESTING HABITS OF THE HEN

BY GEO. M. TURPIN

Suitable nesting equipment is essential for the successful management of laying hens. It should be planned to minimize the labor required in gathering eggs, in keeping nests clean and in supplying suitable nesting material. It is also important that the nests be made attractive and satisfactory to the hens. The tendency of hens to lay their eggs on the poultry house floor, in the poultry yard or in "stolen" nests causes serious losses to poultry keepers. It increases the labor of finding and gathering the eggs; it causes the entire loss of many eggs and a deterioration in the quality of many others, and not infrequently it becomes the direct cause of the fowls acquiring the vicious egg eating habit.

This bulletin reports the results of experiments and observations made by the poultry section of the Iowa Agricultural Experiment Station to determine the important factors that influence hens in selecting the place in which they lay their eggs and to learn how they can best be prevented from laying in promiscuous places.

TIME OF LAYING

Practically all hen's eggs produced are laid between 7 or 8 o'clock a. m. and 4 or 5 o'clock p. m.,* while the larger number are generally laid during the forenoon.

The time of day each hen was taken from trap nests provided for a flock of S. C. White Leghorn pullets at the college poultry farm was recorded for the period, March 20 to May 20, inclusive. The first line of table I shows the average percent of the total hens laying during the day which were taken from the nests up to the hour indicated. As a rule the hens were released from the nests about every two hours but the nests were not tended regularly at the same hours each day. The figures given in the table are based on the data secured on those days only when the hens were released from the nests within 30 minutes of the hour indicated. It should be kept in mind that this table is not a record of the time when the hens actually laid, but of the time they were found in the front section of the trap nest waiting to

TABLE I. RELATIVE NUMBER OF NESTS OCCUPIED DURING DIFFERENT PERIODS OF THE DAY

	9 A. M.	11 A. M.	1 P. M.	3 P. M.	5 P. M.
Total per cent of hens laying up to hour indicated	17.7	46.2	73.5	93.0	100
Relative per cent of hens laying for each 2 hour period	17.7	28.5	27.3	19.5	7.0

* All reference to hours in this bulletin are on the basis of the clock before its hands were pushed ahead an hour March 31.

be released. As the nests were tended only about every two hours the record includes all hens that were ready to be released within two hours previous to the time given. The second line shows the average percentage of laying hens that were released from the nests during the different periods of the day.

It will be noted that over three-fourths of the hens laying occupied the nests some time between 9 a. m. and 3 o'clock p. m., that the largest number, 28.5 percent of the total occupying nests at one time, were released at 11 a. m., and that only a slightly smaller number were ready to be released at 1 p. m.

A study of the nesting time of the individual hens making up a flock shows that the per cent of the total eggs laid during any given part of the day varies somewhat for different flocks and for the same flock at different times of the year. Goodale (4) in discussing the rhythm of egg production says, "Most hens lay for a period of several days and then skip one. The first day of the series the hen lays early in the morning. The time she lays the next day depends largely upon the character of her particular rhythm. If the rhythm is such that she lays only every other day, she usually lays about the same each day, i.e., 10, 0, 11, 0, 10, 0, 11. If she lays two days out of three, the first is laid during the morning and the second during the afternoon, i.e., 10, 3, 0, 10, 2, 0, 9, 1, 5, 0. As the period lengthens, the number laid in the morning increases until the larger portion are laid before noon. Thus: 8, 9, 10, 10, 10, 10, 9, 10, 9, 5, 11, 5, 11, 11, 2, 2, 4, 0."

Under the heading types of rhythm he says, "As a working basis, we may assume an egg a day as a standard rhythm, and altho this rhythm is rarely reached for extended periods we may refer the observed rhythm to it. Some hens lay every other day or a 1-2 rhythm, others two days out of three, or a 2-3 rhythm, still others a 3-4 rhythm and so on. Occasionally the series may be repeated without the intervention of a zero day.

"None of these types are characteristic of any one hen. Many individuals, however, seem to center about a 2-3 rhythm, sometimes falling to the 1-2 type. They do not often, except in the spring, exceed the 3-4 type."

Patterson (10), using the term cycle to mean the number of eggs a hen lays without missing a day and the term rhythm to mean the regularity in the repetition of the cycle has reported that "where hens lay cycles of more than four eggs, by far the greater per cent are laid in the forenoon."

He continues: "In a test made where several hundred hens, the high producing hens were selected by using the March trap nest record, the test being based on the rhythm and cycles of egg production. All hens selected as high producers averaged 163 eggs each during the year. Those selected as low producers averaged 118 eggs, making a difference of 45 eggs.

"In another test using an equal number of hens, all of which had a cycle of four eggs or more during March, averaged 156 eggs in the year; all of which had a cycle of two eggs or less, averaged 110 eggs each.

"After studying the rhythm and cycles of egg production, and comparing this method of selection of profitable hens with other methods, I find that it is just as reliable as any other method."

According to these reports a greater proportion of the eggs would be laid during the forenoon in flocks made up of high producing hens than in flocks made up of poor or mediocre individuals. Few of the Leghorns used in securing the data produced here laid as many as four eggs in a cycle and none produced more. A large per cent of the egg production showed uniformity, both from the standpoint of daily egg production and from that of the time of day the eggs were laid. Table II gives the individual records of 25 hens arranged according to their cycle of egg production. The first 6 hens adhered closely to a single egg cycle, the second 6, to a two egg cycle, the third 6 followed a three and four egg cycle and the last 7 did not follow any one particular cycle, showing, according to Patterson, (10) a poor rhythm of production. A marked correlation between the number of eggs produced in a cycle and the time of laying from day to day will be noted in every case as well as a marked tendency for each hen to exhibit an individuality with regard to the time of day spent on the nest. For instance, hen No. 1189 was always ready to be released from the nest between nine and eleven o'clock except on two occasions when she laid two eggs in a cycle. The hens laying a single egg cycle followed a given schedule closely, but laid somewhat later in the day. Hens following a two egg cycle invariably laid the first egg of the cycle in the forenoon and the second egg enough later in the day to prevent them from being ready to be released from the nests before afternoon. When three or four eggs were laid in a cycle the first egg was always laid earlier and a larger per cent of the total eggs were laid in the forenoon than was the case in cycles of one and two eggs. The larger the per cent of high producers in a flock the larger will be the per cent of eggs laid in the forenoon. Unless high producing hens spend less time on the nest in laying than mediocre and poor hens, a larger per cent of the total hens laying in any one day will be ready to occupy the nests at the same time.

THE HEN'S SELECTION OF THE NEST

In order to secure definite information regarding the time hens spend on the nest in laying and the time they devote to selecting the nest in which to lay, the writer during the latter part of May, 1917, made close observations on a flock of about 40 S. C. Rhode Island Red pullets and of a flock of about 50 S. C. White

TABLE II, PART I. SHOWING REGULARITY IN TIME OF NESTING

(The first line opposite each hen number is record for March and April, the second line for April and May)

Hen No.	Day of Month																												
	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1189		10	4		10		10		9		10[1]	2		10		10		9		10		10		12[1]	12[1]		10			2[1]		
		2[1]		11		1[1]		10[1]				..					9	11	11		11		12[1]		9		10		2[1]	3	11
1198	10		12		11		10		12		12		11		12		11		11		10	10									
	1		11		12		11		11		10[1]	..	12				11		11		10[1]	3[1]		12		10	3		12		12
286	2		2		1		12		12		12		12		12		12		12		2		11		2		12				
	4[1]		11		12		11		11		12	..		11		12		11		10	2[1]		12[1]	3		2		10	3		10
371		?[2]		1	10	2		9	4	12	12	..	11		9	3	12	11	1	11	2[1]	2	1		11	12	10	12	12			
								11					11		10																
374	2		2		1		12		12		1		3		12	3		2		12		12		2		2		2			
		2[1]			2		2		2		2	..		2		2		12		2			1		11		12				2
377	2		2		1		2		2		1			12		2		2			2		2		2		3[1]		2[1]		
			12		12		11		2		2	..		11		10		11		11		12		12	4		12	4		1	2
369	10		10	2		10	2		9	3		11		10	2		9			10	2		10	2		10		10		10	
			10		11	2		10[1]		9		..	11		10	2		11		10	2[1]		9	1		10	1		12	3	
1175	1	10	2		10	2		9	2	2	10	2		10	2		9	2		9	2		10	4		10		12		10	
			11		11		11		10[1]			..	9	2																	
375		10	2		10	2		10	2		10	2		10	2		9	2		9	2		10	2		10		11	3[1]		11
		11		11[3]		1[1]		10[1]	4		10	..		11		11		11		10	2		9	3		?[1]		10	3		11
1166	9	3			11	10	2		9	1		11	3		9	2		9	2		10	2	10	2		10				10	
			10		9	2		10[1]	2		11	..	2		10	2		9	1		10[1]	3[1]		9	1			8	1		10	
246	2		10	2		10	3		9	3		9	3		9	3		9	2		9	2		9	2		9	2				
		9	3		10	2		11	3		10	..	2		10	3		9	1		10	2		9	1	4		10		9	4
88		12			10	2		9	2			9	3		9	3		9	2		9	2		9	1		9	2				
		9	3		9	4		10[1]	4		10[1]	..	2		10	2							9	1	?[2]	1	10	4	7	10	2
																										9				10	3

[1] Hens not released within more than 2 hours. [2] Hens laid, but time of day unknown.

TABLE II, PART II. SHOWING REGULARITY IN TIME OF NESTING

(The first line opposite each hen number is record for March and April, the second line for April and May)

Hen No.	Day of Month																												
	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
285		10	2	4		10	12	3		10	1	4		10	12	3		9	12	4		9	2		9	2		10	2		8
	11	4		10	4		9	4		9	2	..		9	2		11	4		12	4		9	3		10	1		9	3
1178	9	2		11	2		10	2		9	12	3		10	2		9	?[2]		10	4		10	12[1]	2		9	2[1]			2
		9	3		9	2		10	11	3		..	10	2	4		9	12		9	12	3		7	9	4[1]		10[1]	10	1	
288	?[2]	4		11[1]	4		10	2	4		10	2	4		12	4		9	12	4		9	11	4		9	12			10	11
	1	4		10	2		9	11	2		10[1]	..		11	4		9	2		9	12	3[1]		9	11	4[1]		10	1	4	
99	9	2		11[1]	10	2		9	12	3		9	12	3		10	11	4		9	10	2		9	11	3		10	11	2	
		2[1]		10	11	2		10[1]	10[1]	2		..	9	11	4		8	12	3		10[1]	10	1		2[1]	4[1]			9	12	3
1192	4		9	2	4		10	11	4		10	12	3		9	11	4		8	11	4		10	12[1]	4		8	12	4		10
	4		11		12		9	1		11		..	?[2]	?[2]		9	2		9	4		9	12	3		9	12	3		9	
291		10	12	4		10	2		9	12	4		11		9	11	4		8	10	2	4			9	2	4			12	4
		9	3		9	2		10[2]	2		10[2]	..	11	4		9	2	4		9	10[1]	12	3			10	1	4		8	1
1171	3		10	2		10	2		9	1	4		12	2	4		9	2		10	12	2		9	2		9	12	4		10
	1		9	1		1[1]	3		10	3		..	10	4		10	2		11	4		9	12	3		9	1	4		9	3
367	9	3		11	4		2		12	4		12		12		11	4	2		12	12		11	4	4		2		2	2	
				1		1[1]			4		2	..		11		10	2		11	4		12	4		9	4[1]		11	3	8	1
245	2		12		10	2[1]	2	12		10	2		12	2			9	2		10	2		10	4		10	3[1]		10	2	
	10	4		12		1[1]	2		10	2		..	10	2		2		11		10	2		9	12	4		9	11	3		8
258	10	3		11	2		10	3		10	2		11	3		10	12	4		10	12	2		12[1]	2		11		10		
				12		9	2		10	2		..	10	4		10	2		9	11	2		9	12	4		8	1		10	
354		10	4		10	?[2]		9	4		12		12		12	3		2			2		2		10	2	3		12	4		2
		2				1		11	2		10	..	4		10	3		12		2		12		9	2		10	3		1	
362			12		10	2		11		12		11	3		9	3		10	2			12		10	2		10	3[1]		10		10
	4[1]		12		12		9	4		9	2	..		9	2		9	2		10	2		9	1		10	3		12		10
184	9	12	4		10				9	11	3		9	12	4		9	11	4		9	2		9	2	3		10	2[1]		10
	1		9	1		1[1]	3[1]		10[1]	3		..	10	12		10	2[1]		11	4[1]		9	1		9	4[1]		10			11

[1] Hens not released within more than 2 hours. [2] Hens laid, but time of day unknown.

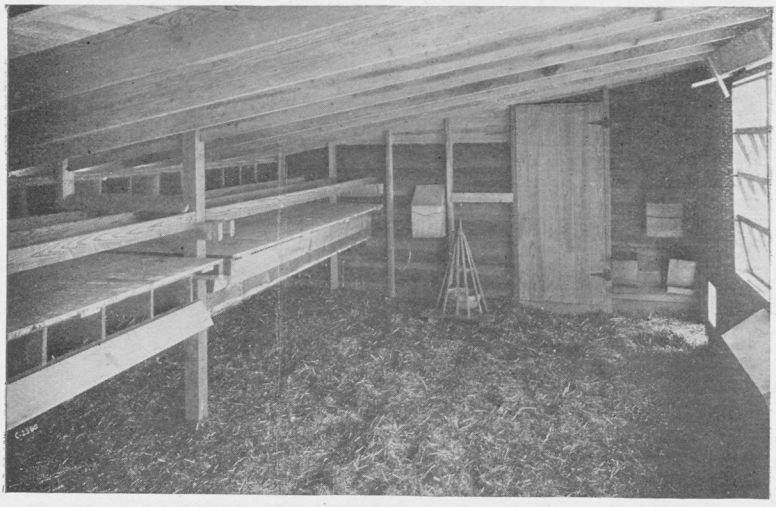

Fig. 1. Nests located under dropping boards. Door is left open to provide exposed nests and closed to provide secluded nests.

Leghorn pullets. A record of the pen of R. I. Reds was taken for two complete days, of the Leghorns for one day. Sixteen 12x14 inch nests that were being used regularly by the stock were continued in use during the period of observation. They were located under the dropping boards and were open both in the front and at the back. A step board on a level with the bottom of the nests at the rear provided a means for the hens to get into the nests readily and the open front permitted the observer to have a clear view of the interior of the nests at all times. Each nest was numbered. At first it was the purpose to keep a record of the time each nest was entered by any of the hens and of the time it was vacated. It was soon found, however, that so many of the hens often passed from one nest to another with such little delay that the observer could not keep track of all the visits. Therefore, a record was kept of only those cases in which the hens sat down and spent at least a minute on the nest visited. It was noted especially that most of the hens appeared to consider their selection of the nest a serious matter and that they spent considerable time and apparently deliberated in choosing it.

Table III shows the total number of visits the hens in each lot made to the nests without laying and the number of visits which lasted for the different periods indicated. It also shows the total number of visits made by each lot, the total time the hens of each lot spent on the nest without laying and the average duration of the visits made.

TABLE III. RECORD OF VISITS TO THE NEST WHEN HENS DID NOT LAY

Variety of Hens	Minutes spent on nests without laying						Total No. of Visits	Total Time on Nests	Per Av. Time Visit
	1-2	3-20	21-40	41-60	61-120	121-180			
By R. I. Reds (40)	8	12	9	1	1	1	32	8 hrs. 4 min.	15 min.
By S. C. White Leghorns (50)	18	10	1	...	1	1	31	6 hrs.	21 min.

The 50 Leghorns made nearly as many visits to the nests during the one day that they were under observation as the 40 R. I. Reds did in two days. They spent nearly three-fourths as much time on the nests visited. If the actual number of times all the hens entered the nests had been counted without regard to the length of time they had remained in them, a relatively larger number of visits would have been recorded for the Leghorns as they made many more very short visits to the nests than the Reds.

No attempt was made to keep a detailed record of the number of times each individual hen visited the nest but it was frequently noted that the same hen visited at least three or four nests, spending from a fraction of a minute to as long as two hours or more on each one before she selected the nest in which she finally laid. In other cases the hen would walk into the nest in which she laid and settle down into it without any apparent hesitation. In some cases this was done when the nest chosen was already occupied by another hen and in such a direct and unhesitating manner when compared with the attitude assumed in most cases that one could scarcely doubt that the particular nest in question had been previously decided upon.

In one or two cases it was observed that certain hens spent considerable time on one or more nests without laying during the day the observations were made. The fact that certain hens sometimes visit the nest regularly from day to day without laying has been reported by a number of poultry investigators. Goodale (4) says, "One of the most interesting things in connection with the rhythm of egg production as observed by Pearl is the existence of hens which never lay an egg, but visit the nests according to a very definite rhythm. We are able to add to this record, for we find the hours of such visits fall into the same sort of rhythm as normal hens. Laying hens often visit the nest at the proper day and hour, but fail to lay."

LENGTH OF TIME HENS SPEND ON NESTS IN LAYING

The relative length of time the various hens under observation spent on the nest in laying is shown in table IV.

The length of time the different hens spent on the nest in laying varied greatly. To what extent, if any this is governed

TABLE IV. LENGTH OF TIME SPENT BY HENS ON NEST IN LAYING AND NUMBER OF HENS FOR EACH PERIOD

	Minutes spent on nest and number of hens for each period							
	10 to 30	31 to 60	61 to 90	91 to 120	121 to 150	151 to 180	181 to 210	211 to 270
S. C. White Leghorns....	2	3	1	6	1	1	1	1
R. I. Reds.....	6	7	9	5	3	0	4	4*

	Total no. of eggs laid	Total time spent on nests	Average time per egg
R. I. Reds.....	38	64 hrs. 56 min.	1 hr. 42 min.
S. C. White Leghorns....	16	25 hrs. 26 min.	1 hr. 35 min.

* One hen included here spent 320 minutes on the nest.

by the time spent in previous visits to the nest during the day is not known. The Rhode Island Reds spent an average of 1 hour and 45 minutes and the Leghorns 1 hour and 35 minutes on the nest for each egg laid. If the total time spent on the nest by the hens of each variety (tables III and IV) be divided by the number of eggs laid in each case, it is found that the Rhode Island Reds spent an average of 1 hour and 55 minutes on the nest for each egg laid and the Leghorns 1 hour and 58 minutes. In other words, both the Leghorn and Rhode Island Red pullets were found to spend approximately 2 hours on the nest for each egg produced. None of the hens in question showed evidence of being broody.*

The length of time the hens spent on the nest both before and after the egg was actually delivered was observed in a number of cases. The first figure of each pair of figures gives the time spent before laying and the second one the length of time spent on the nest after the egg was laid:

32-35; 34-21; 8-189; 78-27; 50-33; 10-3; 22-43; 20-50.**

The first 6 cases out of the 8 noted are for R. I. Reds and the last two for Leghorns. It will be seen that there was a large variation in the proportion of the total time the different hens spent on the nest before and after laying.

DO GOOD LAYERS SPEND LESS TIME ON THE NEST IN LAYING THAN POOR ONES?

In order to secure data on this point, as well as more data on the questions just discussed, a pen of about 60 White Leghorn pullets, a pen of 25 Rhode Island Red pullets and a pen of 65 White Plymouth Rock pullets that had been laying in trap nests for several months were kept under close observation for one day, June 13. The trap nests were closely watched and all

* Jackson (5) states in Bull. Pa. Agr. Exp. Sta. 120 that 60 minutes is about the average time hens spend on the nest in laying. This it will be noted is not in very close agreement with thedata reported here.

** The hen for which this is a record, came directly to the nest in which she laid from another nest which she had occupied 32 minutes.

TABLE V. TIME SPENT BY HENS IN TRAP NESTS IN LAYING

	Min. on nest and no. of hens in nests for different periods							
	10 to 30	31 to 60	61 to 90	91 to 120	121 to 150	151 to 180	181 to 210	211 to 270
White Rocks.....	1	2	6	4	4	0	1	0
R. I. Reds.....	2	1	1	0	2	1	1	1
White Leghorns..	3	8	3	4	3	2	1	1

Minutes on nest	Over 270	Total no. of eggs laid	Total time spent on nests	Average time per egg
White Rocks.....	3	21	44 hrs. 25 min.	2 hrs. 16 min.
R. I. Reds.....	0	9	16 hrs. 25 min.	1 hr. 49 min.
White Leghorns..	1	26	41 hrs. 35 min.	1 hr. 35 min.

hens that were ready to be released were let off the nests at least every 15 minutes. A record was kept of the time each hen went on the nest and of the time she was released and also of number of the hen's leg band in each case. Care was taken to see that a proper record was made when hens visited the nests without laying. Table V shows the relative length of time the different hens spent on the nest when an egg was laid, the figures in the body of the table indicating the number of visits which lasted for the length of time indicated at the top of the column in each case.

As in the case of the fowls kept under observation when common nests were used, a wide variation was found in the time which the different hens spent on the nest in laying. The average time spent on the nest by the R. I. Reds and Leghorns, checks very closely to the figures previously obtained, the R. I. Reds in this case averaging 1 hour and 49 minutes and in the previous test 1 hour and 45 minutes, while the figure obtained for the Leghorns is exactly the same as the former one, viz., 1 hour and 35 minutes. The White Rocks averaged a considerably longer time than the hens of the other two varieties but an examination of the data secured in detail shows that this is largely due to the unusual length of time three of the hens spent on the nest, one of these having been on the nest for eight hours and the other two for over four hours. All hens showing evidence of being broody were excluded.

A number of hens visited the nests and spent more or less time on them without laying, as was the case in the previous test. White Rocks made two such visits, Rhode Island Reds five, and Leghorns five. From the individual hen records kept in this test we are able to report details regarding such visits that were not secured in the previous test. One Leghorn which did not lay during the day spent 25 minutes on the nest. One Plymouth Rock hen spent 2 hours on the nest without laying and 5 R. I. Reds that did not lay during the day spent respectively

15, 390, 440, 165 and 35 minutes on the nest, all of the hens referred to having spent the time indicated in one visit.

Cases in which hens made more than one visit to the nest during the day are as follows, all hens being White Leghorns, except the first which was a White Plymouth Rock:

Hen No. 108 spent from 12:30 to 1 o'clock on one nest without laying, returned to another nest in which she laid and spent from 1:40 to 2:45.

Hen No. 1164 spent from 8:15 to 8:55 on a nest in which she laid and returned to another nest and spent from 9:15 to 9:45 on it without laying.

Hen No. 260 spent from 8:15 to 10:45 on a nest in which she laid and later spent from 12:15 to 12:45 on another nest without laying.

Hen No. 379 spent from 8:30 to 9:45 on a nest without laying, returned to another nest in which she laid and spent from 10:45 to 11:45 and later returned to a third nest and spent from 2:45 to 3 o'clock on it without laying.

Thus hens visit nests and spend considerable time upon them both before and after they have been on the nest in which they laid during the day, as well as spending considerable time there on days when they do not lay at all.

A careful comparison of the time the different hens spent on the nest with the rate of egg production at the time the observations were made failed to show any very marked correlation.

Table VI shows the distribution of the Leghorn hens which laid on the day the observations were taken with reference to the correlation between the rate of production and the time spent on the nest. This is typical of the distribution found for the other varieties, except that it includes a larger number of cases.

The figures in the top line indicate the number of eggs laid between June 1 and June 13 (the day the observations were made) by the number of hens indicated below in each extended column and the numbers on the vertical lines at the left indicate the nearest number of hours spent on the nest by the respective number of hens indicated on the extended horizontal line to the right. For instance commencing on the bottom line, the

TABLE VI. SHOWING ABSENCE OF CORRELATION BETWEEN RATE OF EGG PRODUCTION AND TIME HENS SPEND ON THE NEST IN LAYING

Hours spent by hens on nest	Number of hens, grouped according to number of eggs laid between June 1 and June 13				
	2 or 3 eggs	4 or 5 eggs	6 or 7 eggs	8 or 9 eggs	10 or 11 eggs
	No.	No.	No.	No.	No.
1	1	2	2	5	3
2	1	.	2	3	.
3	.	.	2	1	.
4	.	.	2	.	.
5	.	.	.	1	.

table indicates that one hen spent 5 hours on the nest and laid 8 or 9 eggs. The next line above indicates that two hens spent 4 hours on the nest and laid 6 or 7 eggs each and so on. One-half the hens are recorded on the top line indicating that they spent not over one hour on the nest. Their distribution shows that this half includes the hens which made the highest as well as the lowest egg record during the period in question. More data is necessary to determine whether or not there may be a slight relationship between the number of eggs produced by different hens and the average time spent on the nest for each egg produced, but the data secured seems sufficient to warrant the conclusion that high producing hens do not regularly spend a decidedly shorter time on the nest for each egg produced than do the poor layers.

IMPORTANT FACTORS INFLUENCING THE ATTRACTIVENESS OF THE NEST

Some of the most important factors influencing the attractiveness of the nest are (1) type (2) size (3) freedom from vermin, (4) nature and condition of the nesting material, (5) number of eggs in the nest, (6) presence or absence of nest egg and kind used, (7) and extent to which the nest is secluded. The last three of these points have been made the object of special investigation by the poultry section of the Iowa Agricultural Experiment Station, the results of which are reported in the following pages.

INFLUENCE OF THE NUMBER OF EGGS IN THE NEST

An experiment to determine the influence of the number of eggs in the nest on its attractiveness to laying hens was carried on during a period of 20 days beginning the latter part of February with a flock consisting of about 50 Rhode Island Red hens. They were housed in two pens of the new tile shed roof poultry house recently constructed at the poultry farm. Each pen is 20x14 feet in size and equipped with two sections of nests, each section consisting of eight nests. An interior view of one of these pens showing the nests and their location is is shown on the opposite page. The door between the two pens was kept open, allowing the hens to move freely from one pen to the other. The nests in each section were numbered from left to right and a daily record was kept of the eggs laid in each one. Starting out the morning of the first day, nest No. 1 in each section was provided with 1 hen's egg marked so that it could readily be distinguished from any of the eggs laid during the test, as were all the eggs used as nest eggs in the experiment. Nest No. 3 in each section was provided with 2, nest No. 5 with 3 and nest No. 7 with 4 such eggs, thus leaving every other nest vacant and making a total in all of 16 vacant nests, 4 nests containing 1 nest egg, and an equal number contain-

TABLE VII. SHOWING INFLUENCE OF NUMBER OF NEST EGGS

Number of nest eggs	0	1	2	3	4
Number eggs laid in nest	86	146	120	92	91
Percent of total number of eggs laid in each nest	16.1	27.3	22.4	17.2	17.0

ing 2, 3, and 4 nest eggs, respectively. Each succeeding evening thereafter at the time the eggs were gathered the nest been in nest No. 8 of each section and these were transferred to nest No. 1. The first line of table VII shows the average number of eggs laid in four nests where no nest eggs were used and the total in each four nests that were provided respectively with 1, 2, 3, and 4 hen's eggs used as nest eggs. The second line shows the proportion of eggs laid in each nest when provided with the respective different number of nest eggs by using 100 as the proportion for each vacant nest.

As the eggs were gathered only at the end of the laying period of the day this table does not represent the actual relative attractiveness of nests containing the respective number of hen's eggs indicated. Had the eggs been gathered as soon as laid undoubtedly the nests not provided with nest eggs would have been less attractive than the table indicates, for as soon as one egg was laid in one of these nests it became as attractive as any of the nests containing one of the regular nest eggs. On the other hand, had the eggs been thus promptly gathered the nests containing two or more nest eggs would probably have compared more favorably with the nests provided with only one. The relatively large number of nests used would tend to reduce this tendency, however, so that the data does show that a nest is very much more attractive than otherwise when it contains at least one egg and that it becomes decidedly less attractive when it contains more than three or four.

THE USE OF NEST EGGS

Since one or two hen's eggs make the nest decidedly more attractive the question naturally arises as to what extent the common artificial nest egg would serve the same purpose. There are a number of reasons why the use of real eggs for nest eggs is not to be recommended if the common artificial glass or china egg will make the nests equally attractive. The artificial egg is cheaper, more desirable and more sanitary and there is not the danger of fouling the nest that accompanies the use of the natural egg. As far as the writer is aware, however, no data has ever been reported bearing upon the question as to whether or not the use of the artificial egg increases the attractiveness of the nest. In order to secure information on this point an experiment was carried on for six weeks with a flock of about 40 Rhode Island Red pullets. They were housed in one of the pens of the poultry house previously described so that there were 16 nests for the 40 hens, or an average of 2 nests for each five hens. This gave

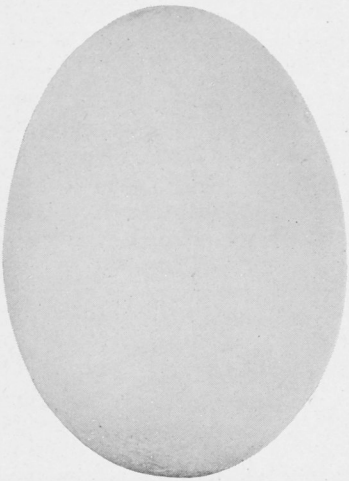

Fig. 3. Glass nest egg

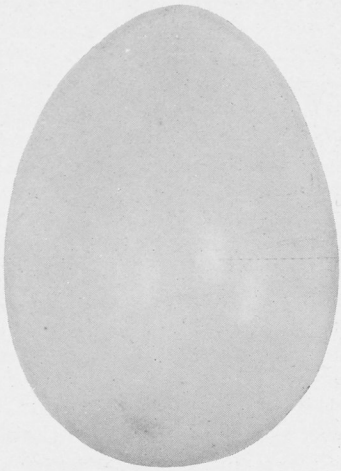

Fig. 2. Hen's egg

Fig. 4. Wooden nest egg

Fig. 5. Plaster of paris nest egg

the hens a greater opportunity in choosing the nest they preferred than would have been possible with fewer nests. Each nest was numbered and one glass egg was used in each of four of the nests, one marked hen's egg was used in each of four nests and as in the experiment previously noted every other nest was used without a nest egg, and the nest eggs were shifted each evening in regular order.

The following table shows the results of the test.

TABLE VIII. SHOWING ATTRACTIVE VALUE OF VARIOUS NEST EGGS

	China nest egg	Hen's egg	No nest egg
Average no. of eggs laid in 4 nests	214	290	108
Percent total eggs laid in each nest	35.0	47.4	17.6

Both the china egg and the hen's egg made the nest much more attractive to the hens, but the china eggs proved much less attractive than the hen's eggs, there being 98 per cent more eggs laid in the nests in which china nest eggs were used and 169 per cent more eggs laid in the nests in which hen's eggs were used for nest eggs than in the same number of vacant nests.

DIFFERENCE IN WHITE AND BROWN EGGS AS NEST EGGS

In order to determine whether or not the difference in the effectiveness of the hen's egg and the china nest egg was due to a difference in color, 10 Rhode Island Red hens were used in an experiment in which white eggs were compared with brown eggs used as nest eggs. The result of the test showed that this was not the case. Fifty-five eggs were laid in the nests in which a white egg was used and 51 eggs were laid in the nests in which a brown egg was used. There were no vacant nests in this case, but an equal number of white and brown eggs were used and these alternately changed each day from the odd to the numbered nests, or vice versa.

WOODEN EGGS AS NEST EGGS

An experiment was then carried on in which wooden nest eggs that had been carefully turned at the college pattern shop from common poplar were compared with the hen's eggs, the china egg and vacant nest. In this case the number of vacant nests used was the same as that for each of the different kind of nest eggs mentioned. The nest eggs were shifted from nest to nest each day as in the experiments previously mentioned. Two pens of S. C. White Leghorns and four pens of Rhode Island Reds were used in this test. About one-third of the eggs were laid by the Leghorns and two-thirds by the Rhode Island Reds. The following table gives a summary of the results:

TABLE IX. COMPARATIVE VALUE OF WOODEN AND CHINA NEST EGGS

Kind of nest egg used	No. nest egg	Hen's egg	China nest egg	Wooden nest egg
Total number eggs	43	81	69	100
Percent of total no. found in each nest	14.7	27.6	23.6	34.1

TABLE X. COMPARISON OF WOODEN, PLASTER OF PARIS, AND HEN'S EGGS, USED FOR NEST EGGS

Kind of nest egg used	No. nest egg	Hen's egg	Wooden nest egg	Plaster of Paris nest egg
Total number of eggs	96	186	200	212
Percent of total number found in nest	13.9	26.8	28.8	30.5

As in the previous experiment the china egg added decidedly to the attractiveness of the nest when compared with nests in which no nest eggs were used, but in contrast to the previous experiment failed to prove decidedly less attractive than the natural eggs. The surprising result of this test, however, is the figures secured for the wooden nest egg. It turned out in this case at least, to be much more attractive than the natural egg!

PLASTER OF PARIS EGGS AS NEST EGGS

In order to further verify this unexpected result the experiment was repeated with the same pens of stock as before and a homemade plaster of paris nest egg was substituted for the china egg. The experiment was carried on in March and April and more eggs were laid than in the previous test which was conducted in January and February. Therefore the nests were more often occupied when some of the hens wished to lay, giving them less opportunity to exercise a wide choice. A more nearly equal number of eggs in the different nests would therefore be expected. Table X gives a summary of the results.

All the nest eggs tried decidedly increased the attractiveness of the nest and, as in the previous test, the wooden nest egg

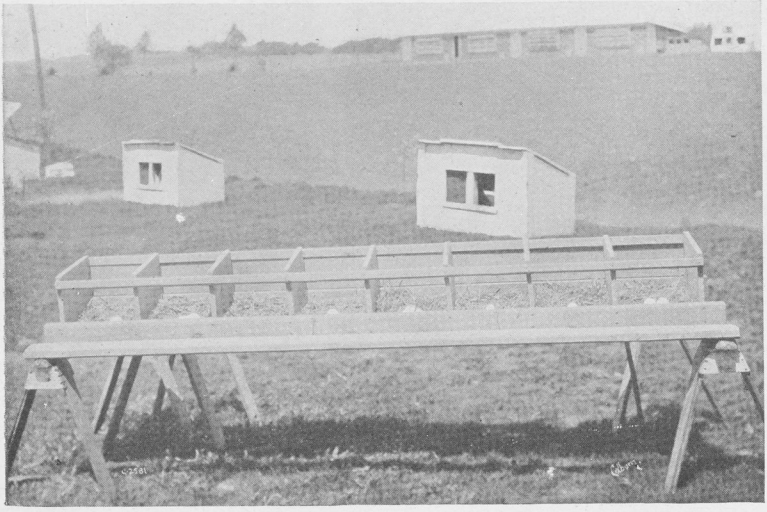

Fig. 6. Rear view of section of nests used in experiments

attracted more hens to the nest than the hen's egg. The plaster of paris egg proved even more attractive than the wooden egg or hen's egg.

THE INFLUENCE OF SECLUSION ON THE ATTRACTIVENESS OF THE NEST

Although secluded nests are commonly recommended to poultry keepers as preferable to others, no actual experiments or observations have been reported to substantiate the claim that they are more attractive or more satisfactory to the laying hen. In order to secure definite data on this point a flock of Rhode Island Red pullets housed in the new tile poultry house previously mentioned was placed in an experiment for a period of one month commencing the middle of February. They were housed in two pens but with the door between them kept open so that the hens could move freely from one pen to the other. Each pen was provided with two sections of nests, each section consisting of eight nests. During this experiment one section of nests in each pen was kept closed and the other one open. A clear idea of the location and construction of the nests used can be obtained from figs. 1 and 6. Each day when the eggs were gathered the section of nests that had been open in each pen during the day was closed and the other one was opened to be kept thus for the next day. This eliminated the effect of any expected. Table X gives a summary of the results.

A total of 535 eggs was laid in the 32 nests during the experiment. Of these, 251 eggs or about 47 per cent of the total, were gathered from the exposed or open nests and 284 eggs, or about 53 per cent from the closed or more concealed nests. Expressed on the same basis as the results of the nest experiments, for each 100 eggs laid in the exposed nests, 113 eggs were laid in the concealed ones. Altho the result shows a positive advantage for the concealed nest it is not so great as for the use of nest eggs.

THE INFLUENCE OF HABIT

In conducting these experiments the question arose whether or not the use of both the nest eggs and the concealed nests would not have been even more advantageous in improving the attractiveness of the nest if the nests in each case had been kept under the same conditions thruout the entire experiment, instead of being changed each day. It seemed plausible that had this been done there would have been a greater tendency, for certain hens at least, to have gradually acquired the habit of laying in the same nest from day to day, so that the influence of the use of nest eggs and secluded nests would gradually have become even more apparent. In order to test this point and also to secure data on the effect of combining the use of the more attractive nest eggs and secluded nests, another experiment was carried on with the same stock and equipment as was used in

the previous experiment. The pens used were numbered three and four respectively and the two sections of nests in each pen were designated as A and B. In pen 3 the door in the front of section A was kept closed thruout the test and five of the eight nests were each provided with a wooden nest egg and the other three each with a plaster of paris nest egg. The door in the front of section B was kept open thruout the test and no nest eggs were used in it. The same plan was followed in pen 4 except that the door in front of each of the two sections of nests was alternately kept open and then closed from one day to the next and the nest eggs were shifted so that they were always used in the secluded nests of the closed section. The nests of Section A in pen 4 were kept closed in the front and provided with nest eggs on the even days and those of Section B on the odd days of the month. Table XI shows the results of the test carried on from May 6 to May 17.

The results show unmistakably that the kind of nest eggs used and the seclusion given the nests by closing the front of them had a strong influence in determining the place in which the hens laid. On the other hand, the data do not indicate that habit had much, if any, influence in determining the particular nest in which the hens chose to lay from day to day. Altho the somewhat higher per cent of eggs laid in the closed nests of pen 3 than in the corresponding nests in pen 4 might be construed to support such a conclusion, a careful examination of the data will show that this comparative small difference may be accounted for on the basis of mere chance. For instance altho the relative per cent of eggs laid in the open nests from day to day, was always significantly higher than in the closed nests, it was decidedly variable. Further evidence of the plausibility of this view is shown in the fact that there was a difference of five eggs or over three and one-half per cent in the number of eggs laid in Section A and B of pen 4 where both sections of nests were used under as nearly the same conditions as possible. Then again one would have expected the per cent of eggs laid in the open section of pen 3 to become gradually less and more uniform from day to day as the experiment continued had habit acted as an influence in determining the result. Apparently a hen cannot be depended upon to lay in any particular nest from day

TABLE XI. SHOWING COMBINED INFLUENCE OF NEST EGGS AND SECLUDED NESTS

Day of month		6	7	8	9	10	11	12	13	14	15	16	17	Total eggs laid	Percent section nests
Eggs laid in pen 3	Sec. A	16	13	17	17	12	21	22	17	17	14	18	16	200	91.7
	Sec. B	2	0	3	0	1	1	0	0	3	1	6	1	18	
Egg laid in pen 4	Sec. A	12	1	9	1	9	1	11	3	11	1	7	0	*66	87.6
	Sec. B	3	11	0	9	5	14	0	10	0	12	2	5	71	

* Of the 137 eggs laid in pen 4, 120 were laid in the nests when they were closed and provided with nest eggs and 17 were laid in them when they were otherwise.

to day as a mere matter of habit but only because she finds it attractive and comfortable each day she uses it.

HOW MANY NESTS SHOULD BE USED?

The number of nests commonly recommended varies greatly. For instance, Lewis (8) says "a safe number is one nest to every three or four layers." Lee (7), Kemster (6) and Quisenberry (11) recommend one nest to every four or five hens, Dryden (3) says one nest to five or six hens should generally be provided, Benjamin (1) says one nest to six hens is usually sufficient and Lippincott (9) says there should be one nest for every ten hens in farm flocks of ordinary size.

If a sufficient number of nests is not provided to accommodate all the hens that wish to lay at any one time there are but three possible alternatives for the hen. She may appropriate a nest already occupied, lay somewhere else than in one of the nests provided, or wait until some other hen leaves the nest. The fact that most hens closely follow a definite time schedule in laying makes it appear doubtful whether it is possible for hens to long delay the time of laying, even if they desired to do so. Observations made in securing the data for this bulletin further support the idea that hens cannot be relied upon to adopt a watchful waiting policy in this regard. To prevent hens from laying on the floor, in the poultry yard or in "stolen nests," and to prevent the broken eggs often resulting when more than one hen attempts to occupy one nest at the same time, it is necessary to have as many nests as there are likely to be hens wishing to lay at one time. Our data show that for each egg produced by a flock one nest is occupied for an average of two hours and that during the months when egg production is heaviest we may often expect at least a third of the laying hens wishing to occupy the nests during the same two hours of the day. As a flock of good layers will not infrequently produce as many as three eggs for each four hens in the flock it would seem that one nest for each four or five hens would not be more than a safe number to provide and in the case of flocks of less than 100 fowls where chance is an important factor there should be even more nests.

TYPE AND LOCATION OF NESTS

The nests and their location in the poultry house should be planned with reference to convenience in gathering the eggs and keeping the nests clean and free from vermin as well as making them attractive to the hens. One of the commonest locations for the nest is beneath the perches. This necessitates the use of a good tight dropping board to prevent the nests from becoming contaminated. When such a dropping board is used there are some advantages as well as some disadvantages in locating the nests under it. The nests and roosts are the most common places to become infected with mites and the use of

these two classes of fixtures together may tend to increase the difficulty of exterminating this pest. If there are more than two or three roosts the use of nests under the dropping board cuts off access to the wide floor space to the rear and because of the seclusion afforded increases the tendency of the hens to lay on the floor where the eggs are difficult to gather. On the other hand, this location permits the use of cheaper and more simply constructed nests than is required elsewhere, and most readily affords the desirable seclusion for the nests. Plans for very satisfactory types of nests, one for the location under the roosts and one for the wall, are submitted herewith. Recently a number of poultry keepers have been using and recommending a nesting box without partitions in it. Partitions, however, make each nest more secluded and hold the nesting material in shape once the nest has been made. The writer has observed that hens prefer to adopt a nest in which the nesting material has already been moulded into shape, rather than to arrange the nesting material in shape themselves. The dimensions given are for nests designed for medium sized breeds such as the general purpose breeds. They may be made slightly smaller for the smaller breeds and somewhat larger for the largest breeds.

HOW FREQUENTLY SHOULD EGGS BE GATHERED?

One of the most important measures that can be taken to prevent deterioration in the quality of eggs is to keep them cool. The development of the chick embryo of fertile eggs, the breaking down of the albumen, weakening of the yolk membrane and the evaporation of water from both fertile and infertile eggs constitute the most serious losses in egg deterioration and these all take place most rapidly at warm temperatures. Both fertile and infertile eggs will suffer a greater deterioration in quality each hour they are held at a temperature equivalent to that of an occupied hen's nest, than they will each day when kept under favorable storage conditions. With most of the eggs being laid in the forenoon, but with a significant number of hens laying in the afternoon and spending an average of two hours each on the nest, considerable deterioration of a large per cent of the eggs will be prevented by gathering them at noon and again during the evening. If care is taken not to disturb the hens more than necessary the nests will be made even more attractive to the remaining hens as has been shown by the observations reported elsewhere in this bulletin. Gathering the eggs twice each day is, of course, more important during warm weather but it also helps to keep the eggs clean when the hens are on range during wet muddy weather.

The ideal conditions for maintaining the hatching quality of eggs held for incubation seem to be somewhat different than those required for preserving the quality of eggs considered from the standpoint of their value for human food. In main-

taining the hatching quality of eggs it is necessary to provide conditions that will maintain the life and vigor of the germ as well as the food material that has been put in the egg to nourish the embryo through the period of incubation. It is interesting to note in this connection that the hatching quality of eggs is more effectively maintained if they are warmed up each day so that they are subjected to the same temperature conditions that they receive when they are laid in the stolen nest. Jackson (5) found that by placing under hens for sixty minutes each day the eggs that were being held for some time for incubation, the number of vigorous chicks hatched was increased 10 per cent. What would be the effect of holding the eggs at such a temperature for a longer period each day has not to the writer's knowledge, been determined, but since the hen using a stolen nest probably spends as much time on the nest as when laying under the conditions of the tests reported herewith it is probable that two hours of such heating would not prove detrimental. Further investigation is needed before one can safely conclude that gathering the eggs more than once each day during moderate or warm weather is beneficial from the standpoint of their hatching quality.

INFLUENCE OF ATTRACTIVE NESTS ON EGG PRODUCTION

Little is known as to what extent the nature and location of the nest and the use of nest eggs influence egg production. Brown (2), an English poultry authority, says that the removal of the eggs from the nest has been one of the important factors in bringing about increased egg production in the domestication of the fowl. The regular removal of the eggs from the nests of certain wild birds results in a marked increase in the number of eggs produced in a clutch. The experience of poultrymen in the management of geese, particularly, has led them to believe that the regular removal of the eggs from the nest will postpone broodiness and result in the production of more eggs during a season. Altho we do not have sufficient evidence to warrant the conclusion that the use of secluded nests and nest eggs have such a marked influence upon egg production directly, it is not too much to assume that their use will indirectly increase production just as the use of any other measure which adds to the general contentment and comfort of the stock may be expected to do so.

SUMMARY

1. On the average nearly 56 per cent of the hens laying occupied the nests between 9 a. m. and 1 p. m.

2. The relative per cent of hens ready to leave the trap nests after laying during the different periods of the day was as follows: To 9 a. m., 17.7 per cent, 9 to 11 a. m., 28.5 per cent, 11 a. m. to 1 p. m., 27.3 per cent; 1 to 3 p. m. ,9.5 and 3 to 5 p. m. 7 per cent.

3. A study of individual nesting records shows that a large per cent of hens adhere closely to a uniform schedule of egg production both with regard to daily egg production and the time of day spent on the nest in laying.

4. Hens which lay regularly every other day lay at about the same hour each day. Hens which lay two eggs on consecutive days and then miss one day, lay the first egg of the cycle at a certain definite hour of the forenoon and the second egg of the cycle during a definite period in the afternoon. Most hens laying three eggs in a cycle lay the first egg comparatively early in the forenoon, the second one somewhat later in the forenoon and the third one at a definite period of the afternoon. Hens laying more than three eggs in a cycle lay a larger proportion of their eggs during the forenoon than hens laying a smaller number of eggs in a cycle. Therefore, the larger the number of high producers there are in a flock the larger will be the proportion of eggs laid during the forenoon.

5. Hens give considerable attention to the matter of choosing the nests in which they lay. They usually visit a number of nests and spend some time on them before selecting the nest in which they finally lay.

6. Considerable variation was found in the length of time hens spend on the nest in laying. The average was found to be 1 hour and 35 minutes for each of two tests made with White Leghorns, 1 hour 45 minutes, and 1 hour and 49 minutes respectively in two tests with R. I. Reds and 2 hours and 16 minutes in one test with a flock of White Plymouth Rocks.

7. When the total time spent by the hens on nests when not laying was added to the total time spent when laying, an average of about 2 hours for each egg produced was found in each case.

8. The proportion of the total time spent on the nest before and after the egg was actually delivered varied greatly.

9. No correlation was found between the rate of egg production of different hens and the average length of time they spent on the nest in laying each egg.

10. Hens frequently visited the nests and spent considerable time there on days when they did not lay.

11. Nests were found to be much more attractive to the hens when they contained at least one egg and to become less attractive as the number of eggs was increased to more than three or four.

12. Hen's eggs were found to be more effective when used as nest eggs than the common glass or china egg. The relative number of eggs laid in nests furnished with no nest egg, china egg, and hen's egg, was respectively 100, 198 and 269.

13. Wooden nest eggs were found to increase the attractiveness of the nest more than the use of the hen's egg used as a nest egg. A comparison of nests furnished with no nest egg,

glass egg, hen's egg and wooden egg resulted in the following relative number of eggs being laid in each differently furnished nest: 100, 160, 184 and 233 respectively.

14. A homemade plaster of paris nest egg was found equal to the wooden egg and superior to the hen's egg for increasing the attractiveness of the nest. The following numbers show the relative number of eggs laid in nests furnished respectively with no nest egg, hen's egg, wooden egg and plaster of paris egg: 100, 194, 208 and 221.

15. Concealed nests were found to be more attractive to the hens than exposed ones. The relative number of eggs laid in each kind was respectively 113 and 100.

16. Concealed nests furnished with nest eggs were found decidedly more attractive to the hens than exposed used without nest eggs. In one case 91.7 per cent of the total eggs produced were laid in such nests and in another case 87.6 per cent.

17. Habit does not seem to play a strong part in determining the particular nest in which a hen chooses to lay from day to day.

18. At least 1 nest for each 4 or 5 hens seem to be required to fully meet the needs of the average farm flock.

19. Gathering the eggs twice daily, particularly during warm or wet weather will prevent considerable deterioration in the quality of egg produced.

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